Current Status of Analysis of PT Supernova Data

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Introduction

We now have test data from the Photometric Telescope for 2 supernovae discovered in newly acquired SDSS spectroscopic data. We have named them according to the plates in which they were discovered. The first is SN1598; the 2nd is SN1744. We discuss the current state of our analysis below. While the analysis is still very rough, we believe that there is enough information to conclude that this is useful data. We would like to proceed with this program, in order to acquire data while we refine the analysis.

Thanks to the efforts of Mark Subbarao, it is now possible to search for supernovae in SDSS spectra the day after they are acquired, allowing for a first follow-up with the PT as soon as the following night. This is important, since it is especially valuable if we can discover SN before their peak brightness and measure the light curves through the peak. Don York has time available on the 3.5m telescope for additional follow-up spectra.

We propose to start following the light curves of any newly discovered Type-1a SN, starting with the next dark-run. The youngest SN will get the highest priority. We request an allocation of one hour of PT time per night. Hubert Lampeitl will be responsible for maintaining the manual list, to optimize the target list and exposure times.

Summary of the Current State of the Analysis

John Barentine has obtained observations of both supernovae during bright-time conditions. He observed SN1598 on MJD53042 and MJD53043, and while there was a full moon only 5° away, the parent galaxy/SN is clearly visible. (Since the fiber diameter is only 3”, the SN image is not distinct from the parent galaxy image.) He also obtained observations of SN1744 on MJD53072 and MJD53073 with the near-full moon 36° away, as shown in Figure 1. The galaxy/SN is very distinct, especially in the i filter, and although we need to complete a more detailed analysis, this appears to be useful data.

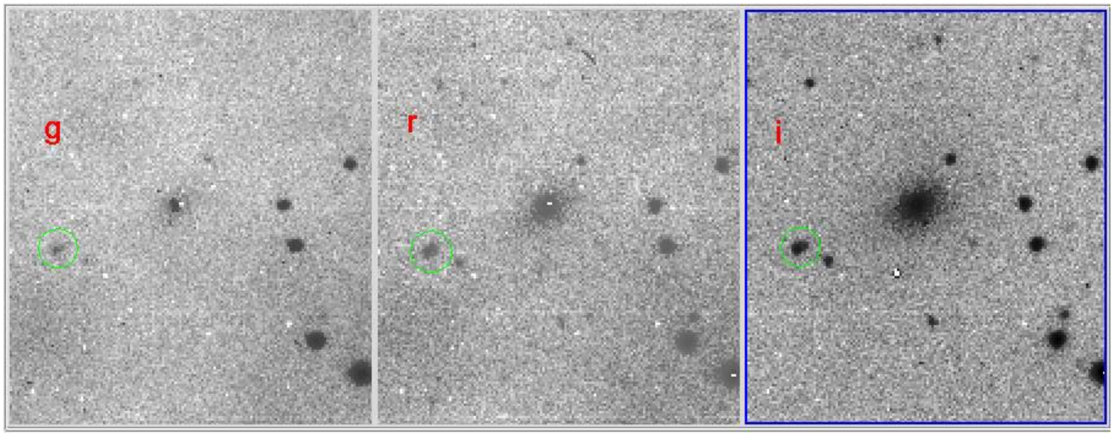

Figure 1: SN1744 observed on MJD53072 in 3 filters, with the near-full moon 36° away.

SN1598 was also observed on MJD53061, and SN1744 was observed on MJD53062, MJD53063, and MJD53066. The data for MJD53062 and MJD53066 were labeled "bad" with comments for MJD53066 that the target was "in clouds." The galaxy/SN was still visible, though attenuated. The conditions for MJD53063 were photometric, and we focus on this data for the rest of this report.

The spectrum for SN1744 is shown in Figure 2. It is a clear type 1A, and the fit returns an age of 9 days on MJD53055, so our observations are taken well past peak brightness.

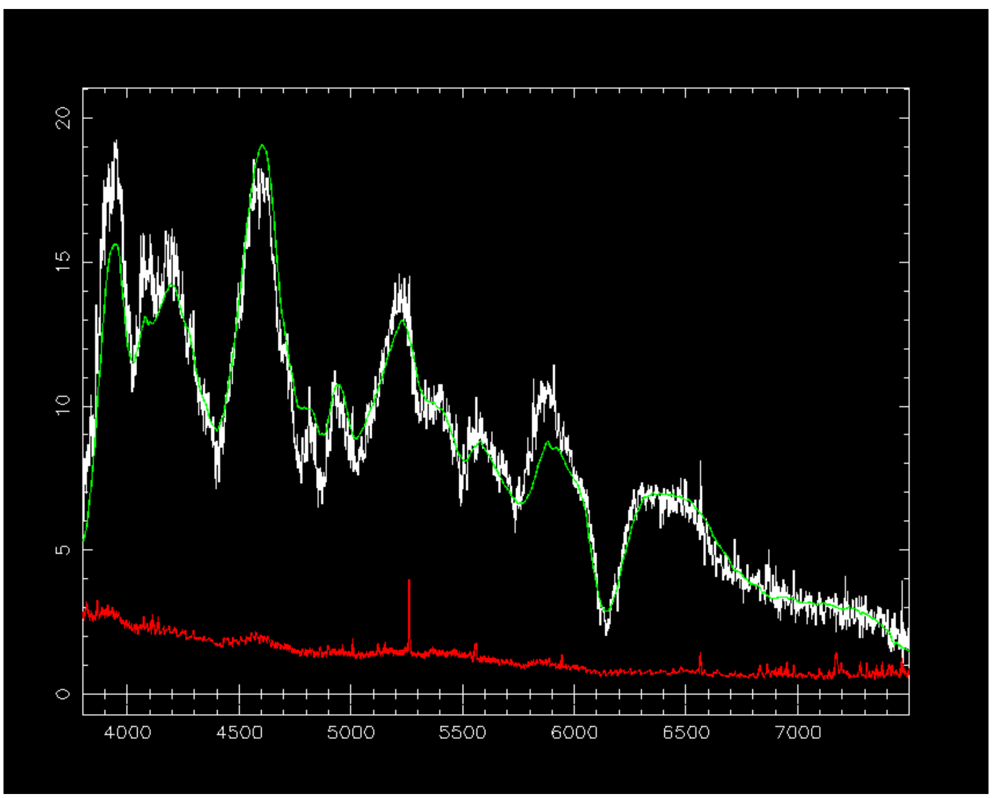

Figure 2: Spectrum for SN1744.

Figure 3 shows the parent galaxy as seen from several co-added exposures with the SDSS 2.5m telescope.

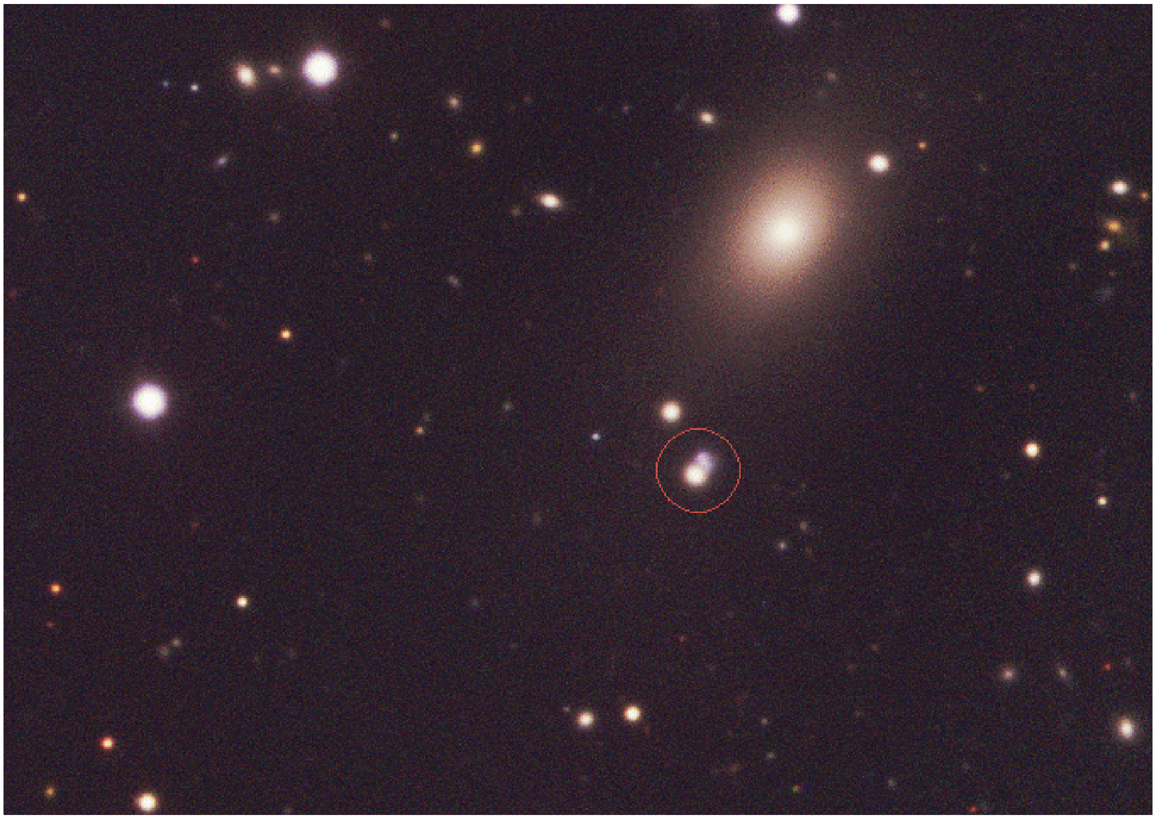

Figure 3: Image of parent galaxy from SDSS 2.5m data.

Since the SN is not separated from the galaxy, we must subtract a template image, taken before the SN explosion, to evaluate the quality of the data. We have taken a 2.5m exposure for the template image. We have used the Pyraf tools to match the PT pixels to the 2.5m pixels, and convolute the 2.5m data to match the PSF of the PT. After a final flux matching step, the images are subtracted. Figure 4 shows the result. It is apparent that the flux matching is not yet perfect: The white spots show that we are over-subtracting. Nonetheless, the excess from SN1744 stands out clearly. While the analysis still needs improvement and we need to evaluate systematic uncertainties, this image at least demonstrates that we can measure the SN flux with the PT.

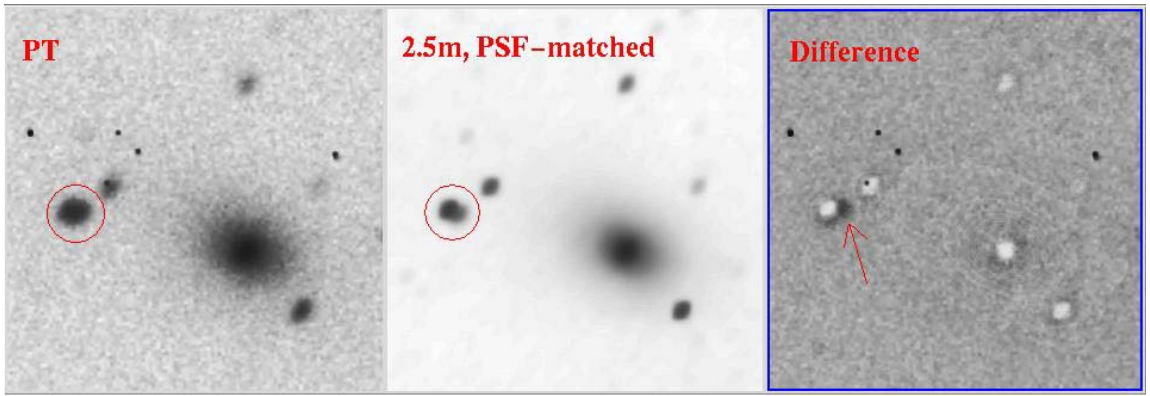

Figure 4: PT g-band image after subtraction of 2.5m template.

To further investigate the flux matching issue, we have compared the flux of objects found by Sextractor in both the 2.5m template image and the PT image. This is shown in Figure 5. Most objects fall on a straight line, demonstrating the correct flux scaling and relative photometry. There are also several outliers, and if Pyraf included one of these in the flux scaling, it could easily generate the observed over-subtraction. The object containing SN1744 is one of the outliers, falling above the line. We would like to do more to understand the other outliers and the statistical uncertainties on the flux. Our preliminary result is that we find a flux of 1705 ± 122 counts for SN1744, showing we can obtain a very good statistical precision for SN in the PT, even when they are well past their peak.

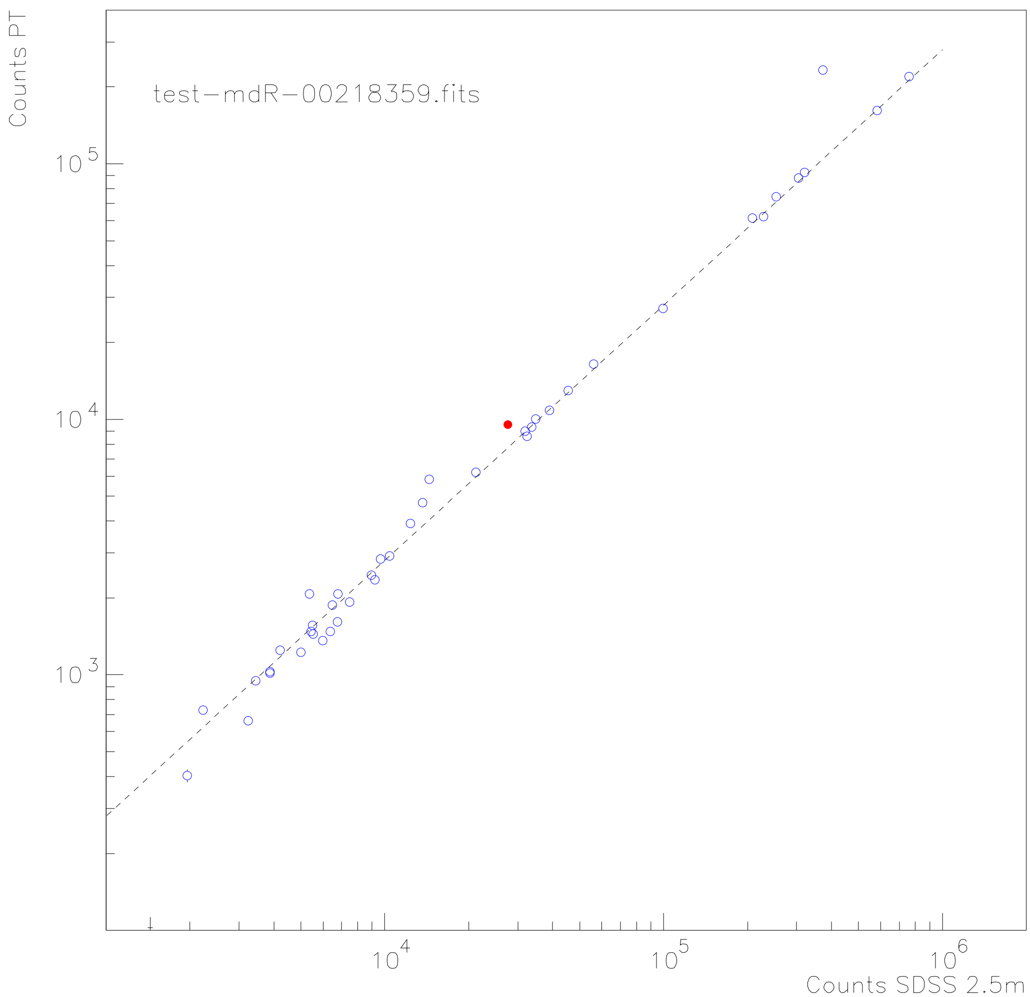

Figure 5: Flux of Sextractor objects for 2.5m data vs PT data. SN1744, combined with the parent galaxy, is shown by the red dot.